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Results on main elasmobranch species captured during the 2001-2014 Porcupine Bank (NE Atlantic) bottom trawl surveys

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Abstract

This working document presents the results on the most significant elasmobranch species of the Porcupine Bank Spanish surveys in 2014 and updates the documents presented in previous years with the information in the whole historical series from 2001. The main species in biomass terms in this survey were Galeus melastomus (blackmouth catshark), Deania calcea (birdbeak dogfish), Scymnodon ringens (Knifetooth dogfish), Dipturus nidarosiensis (Norwegian skate), Scyliorhinus canicula (lesser spotted dogfish), Etmopterus spinax (velvet belly lantern shark), Hexanchus griseus (bluntnose sixgill shark), Dalatias licha (Kitefin shark), Leucoraja circularis (sandy ray), Dipturus cf. flossada, Leucoraja naevus (cuckoo ray) and Dipturus cf. intermedia (common skate). Biomass, distribution and length ranges were analysed for these species. All the species analysed increased its biomass in 2014, except S. canicula and D. cf. flossada that decreased. D. calcea individuals smaller than 65 cm were captured again in 2014 after not having been captured the previous year, although catches were very low. Raja brachyura was recorded for the first time in the survey area.

Introduction

The Porcupine Bank bottom trawl survey has been carried out annually since 2001 to provide data and information for the assessment of the commercial fish species in the area (ICES divisions VIIc and VIIk) (ICES, 2010, 2011).

The aim of this working document is to update the results (abundance indices, length frequency distributions and geographic distributions) on the most common elasmobranch species in Porcupine Bank bottom trawl surveys after the results presented previously (Fernández-Zapico et *al.*, 2013, Ruiz-Pico et *al.*, 2014). The elasmobranch species captured and analysed were: *Galeus melastomus* (blackmouth catshark), *Deania calcea* (birdbeak dogfish), *Deania profundorum* (arrowhead dogfish), *Scymnodon ringens* (Knifetooth dogfish), *Scyliorhinus canicula* (lesser spotted dogfish), *Etmopterus spinax* (velvet belly lantern shark), *Hexanchus griseus* (bluntnose sixgill shark), *Dalatias licha* (Kitefin shark), *Leucoraja circularis* (sandy ray), *Leucoraja* *naevus* (cuckoo ray) and *Dipturus* spp. (common skate) / *Dipturus cf. flossada* / *Dipturus cf. intermedia* / *Dipturus nidarosiensis* (Norwegian skate).

Material and methods

The area covered in the Spanish Groundfish Survey on the Porcupine bank (SP-Porc) (Figure 1) extends from longitude 12° W to 15° W and from latitude 51° N to 54° N following the standard IBTS methodology for the Western and Southern IBTS areas (ICES, 2010). The sampling design was random stratified (Velasco and Serrano, 2003) with two geographical sectors (North and South) and three depth strata (> 300 m, 300 – 450 m and 450 - 800 m) (Figure 2). Hauls allocation is proportional to the strata area following a buffered random sampling procedure (as proposed by Kingsley *et al*., 2004) to avoid the selection of adjacent 5×5 nm rectangles. More details on the survey design and methodology are presented in ICES (2010, 2011).
A revision of haul duration standardization was carried out in 2013, with views to change the abundance estimation from time based to swept area instead on trawling time since it was observed that the trawling time was overestimated, as there were yearly differences in time to reach the ground. Times to ground contact were re-estimated using the logs of the net monitoring system (SIMRAD ITI) and abundances were weighted to 30 minutes (Ruiz-Pico et *al*., 2014).

Results and discussion

In 2014, 80 standard hauls and 5 additional hauls were carried out (Figure 2).
Mean total catch per haul was 1051.8 ± 50.39 Kg S.E. Fishes represented about 95% of the total catch and elasmobranchs made up ca. 9% of the total fish catch. The shark species registered in 2014 in the sampling area, and their respective percentages of the total elasmobranchs stratified catch were: *Galeus melastomus* (57%), *Deania calcea* (17%), *Scymnodon ringens* (7%), *Dipturus nidarosiensis* (5%), *Scyliorhinus canicula* (3.5%), *Etmopterus spinax* (3%), *Hexanchus griseus* (2.5%), *Dalatias licha* (1.6%), *Leucoraja circularis* (1.4%), *Dipturus cf. flossada* (0.8%), *Leucoraja naevus* (0.3%), *Dipturus cf. intermedia* (0.26%), *Deania* sp. (0.23%), *Raja clavata* (0.15%), Deania profundorum (0.1%), *Squalus acanthias* (0.1%), *Leucoraja fullonica* (0.07%), *Raja brachyura* (0.06%) and *Centroscymnus crepidater* (0.04%).
The most remarkable changes in 2014 compared to previous years were the increase on the biomass of all the species analysed, except *S. canicula and D. cf. flossada*, that decreased, also the results on individuals smaller than 65 cm of *D. calcea*, captured again in 2014, after not having been captured the previous year, although catch values were very low. Moreover, *Raja brachyura* was recorded for the first time in the survey area.

Galeus melastomus (Blackmouth catshark)

Blackmouth catshark keeps the highest biomass abundance values among elasmobranchs, with more than the half of the whole catch for this group. Moreover the last three years shows a quantity quite higher than the rest of the capture for the time series.
This species appears to retrieve from the slight decrease of biomass and abundance values from last year, going back to similar values than in 2012 for abundance and a little lower than in 2012 for biomass (Figure 3).
Galeus melastomus usually occurs in the deepest part of the survey area, in the southern sector. In the last survey the capture of this species increased in the southeastern part of

the bank (Figure 4), showing a depth distribution between 189 m and 764 m, although most of the specimens were catch at the range depth between 500 and 600m.
Blackmouth catshark length distribution kept almost unchanged from last year, ranged from 11 cm to 79 cm. The distribution presents three peaks and two marked modes around 51 and 25 cm, a little lower than last year (Figure 5).

***Deania calcea* (Birdbeak dogfish) and *Deania profundorum* (Arrowhead dogfish)**
Though this species have been traditionally analyzed together during the time series, they have been separeted since 2012, as it was reported in previous documents (Ruiz-Pico et. *al*, 2014). Last survey both especies showed an increase in both its abundance and biomass, although *D. calcea* remains representing the most percentage of the *Deania* gender in the area. Analysing both species together, 2014 shows a peak of catch, with the highest value for the historical series, both in biomass as in number (Figure 6; Figure 7).
In 2014, both species showed a deep distribution below 500 m, with *D. calcea* found between 585 m and 764 m and the few specimens of *D. profundorum* extended from 585 m to 764 m, with the difference in that Birdbeak dogfish was captured mainly between 600 and 700m, while Arrowhead dogfish was between 700 and 800.
Deania calcea is distributed in the north and also in the south of the westernmost area, while *Deania profundorum* does it only in the south, showing a slight increase in its abundance in the southernmost part of the bank during last survey (Figure 8; Figure 9).
Regarding length distributions, in 2014, *D. calcea* ranged from 44 cm to 116 cm, with one marked mode around 85 cm and a smaller one around 103 cm, similar to the modes found in previous years (Figure 10). Meanwhile, *D. Profundorum* ranged from 27 cm to 70 cm and presented a mode in 29 cm.
Individuals smaller than 65 cm of *D. calcea were* captured again in 2014, after not having been captured the previous year, although catches were very low (Figure 11). In any case it has to be considered that *D. profundorum* was only identified as a separate species from 2012, therefore part of the small individuals (<65 cm) could belong to his species instead of *D. calcea*.

***Scymnodon ringens* (Knifetooth dogfish)**

Biomass and abundance of *S. ringens* increased in the last survey after the slight decrease of the previous year, recovering the increasing trend from 2010 (Figure 12).
In 2014, the depth range for this species was from 603 m to 764 m and its geographic distribution on the southeastern area of the bank, like in previous years, with greater presence in the east (Figure 13).
The *S. ringens* sizes range increased over last year, being between 29 cm and 114 cm in 2014, with more individuals around 74 and 77 cm (Figure 14).

***Scyliorhinus canicula* (Lesser spotted dogfish)**

Biomass and abundance for *Scyliorhinus canicula* in 2014 showed consistent values with the rest of the time series after the sharp increase of the last year. Even so, the values this year were high compared with the trend of the historical series (Figure 15).
The depth range for this species in 2014 was between 189 m and 382 m.
Lesser spotted dogfish presents a historic distribution in the North area of the Porcupine Bank, specially associated to the Irish shelf, as it was reported before (Fernández-Zapico *et al*., 2013; Ruiz-Pico *et al*., 2014). In 2014 survey, the higher abundance of the species was found in the Northwest area of the Bank, unlike other years, more abundant in the Northeast part (Figure 16).

Length distribution for *Scyliorhinus canicula* ranged from 19 cm to 79 cm and showed a mode in 64 cm (Figure 18).

***Etmopterus spinax* (Velvet belly)**

The stratified biomass for this species increased in 2014 until values reached in 2010 and the increase was even bigger in abundance, nearly doubling the value reached the previous year (Figure 15).

In 2014 *E. spinax* was captured at a depth range between 189m and 382 m.

This species is usually distributed around the central mound of the Bank and it was especially abundant in the Northeast area in this last survey (Figure 17).

As for the length distribution, it ranged between 11 cm and 52 cm, similar to the previous year, though with a mode slighly lower, in 30 cm. Moreover small sizes were particularly abundant in 2014, hence the high values of abundance (Figure 18).

***Hexanchus griseus* (Bluntnose sixgill shark)**

Bluntnose sixgill shark maintained the growing trend in biomass in recent years, reaching the highest value of the time series. As for the abundance it decreased slightly from last year, despite having attained an average value compared with historical series (Figure 19).

Depth range for this species was beteen 189 m and 764 m, showing a wide geographic distribution into de sampling area with no clear pattern, as reported in previous documents (Ruiz-Pico *et al.*, 2014) (Figure 21).

The smallest size recorded in 2014 was 67 cm, that is also one of the most common along with 96 cm, and the largest was 178 cm, the largest one in the time series (Figure 22).

***Dalatias licha* (Kitefin shark)**

As *H.griseus*, *Dalatias licha* strongly increased its biomass, although in this case it also did it consistently in abundance, reaching peaks of the time series for both indices (Figure 19).

D. licha depth range extended between 473 m and 764 m in 2014 and spread out its geographic distribution to the south and southwest, where it was particularly abundant in 2014 compared to the historical series (Figure 20).

Kitefin shark length distribution found in the last survey ranged between 30 cm and 113 cm, with a mode in 41 cm, similar to the one found in the previous year (Figure 22).

***Leucoraja circularis* (Sandy ray) and *Leucoraja naevus* (Cuckoo ray)**

L. circularis maintained the increasing trend from 2010 with a slight increase in the last survey, both in abundance as in biomass, equaling the years with the highest values of the time series (2008 in biomass and 2007 in abundance) while *L. naevus* also experienced a slight increase, recovering from the low values in 2013 (Figure 23).

The distribution of these two rays is very different, both geographically and in depth. Sandy ray is usually found in the western survey area, especially in the north but also in the south, with lower values of abundance. On the other hand, Cuckoo ray dwells around the central mound of the bank (Figure 24).

Regarding depth distribution, *L. circularis* was found from 332 m to 658 m in 2013, while *L. naevus* was captured from 189 m to 315 m.

In 2013, both species showed a lack of individuals under 30 cm, as usual for *L. naevus* in the last five years but not for *L. circularis*. As for lengh range, *L. naevus* went from 33 cm to 61 cm, while *L. circularis* ranged from 32 cm to 103 cm (Figure 25).

Dipturus spp. (Common skate)

Dipturus nidarosiensis, *Dipturus cf. flossada* and *Dipturus cf intermedia* were analysed together with *Dipturus* spp. and also the species separately, as it has been done since 2011 (Ruiz-Pico et al., 2014, Fernández-Zapico et al., 2013).

In 2014, *Dipturus* spp. increased strongly in abundance and particularly in biomass, reaching the highest values for the historical series (Figure 26). Analysing the species separately, this increase occurred in *D. nidarosiensis*, which quadrupled its biomass and tripled its abundance from last year, and also in *D. cf. intermedia*, which doubled both, its biomass and abundance, while *D. cf. flossada* decreased slightly (Figure 29; Figure 30).

Depth distribution for these species in the last year did not differ from previous years (Fernández-Zapico et *al.*, 2013; Ruiz-Pico et *al.*, 2014), extending from 189 m to 736 m. In 2014 *Dipturus* spp. expanded their geographical distribution over previous years. *D. cf. intermedia* was expanded towards the center and southeast, within the northern sector, in a depth range between 189 and 269 m, while *D. nidarosiensis* did it toward the southwest, whereas it increased its abundance in the southeast and it was captured between 402 and 736 m, getting wider its depth range toward shallower areas. However, *D. cf. flossada* was captured in the west and south in the Northern sector, around the central mound of the bank, as usually, and also in the Southern sector for the first time. Its depth distribution ranged from 189 to 345 m (Figure 31).

As for length distribution in 2014, *Dipturus* spp. ranged from 35 cm to 208 cm. When splitting the different species for the analysis of its sizes it is showed that *D. nidarosiensis* reached its lowest size for the last three years, with a capture of 61 cm length, and also the highest size, with an individual of 208 cm length (Figure 32).

Regarding *D. cf. flossada* it ranged from 35 cm, reaching its lowest value, to 130 cm. *D. cf. intermedia,* also reached its lowest value in 2014, with a capture of 50 cm length, and its highest value, with an individual of 120 cm length (Figure 33).

Other elasmobranch species

Other scarce species were found in the area, namely *Raja clavata*, *Squalus acanthias, Leucoraja fullonica, Raja brachyura and Centroscymnus crepidater*. All of them have been reported in previous years in the historical series but *R. brachyura*, which was captured for the first time in the historical series of the survey in 2014. It was only one specimen, a female of 80 cm length with 4370 g, at 315 m depth.

Acknowledgements

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Figures

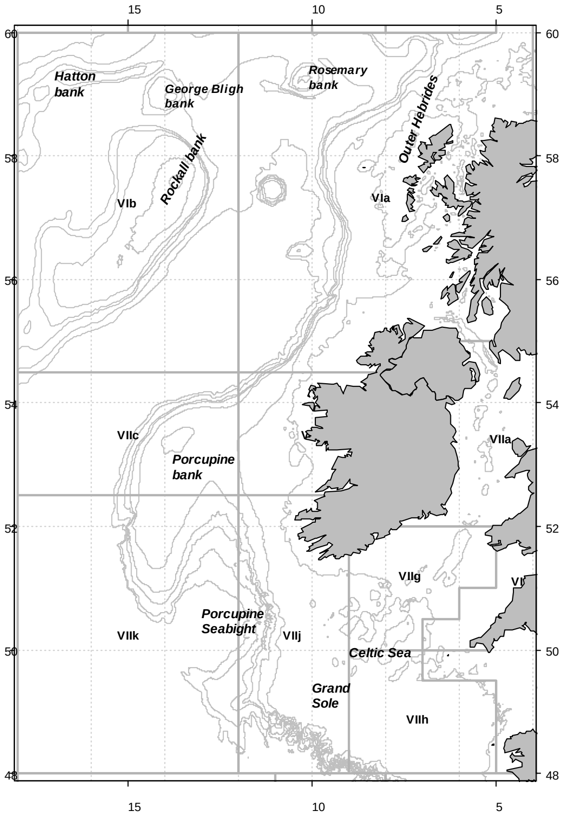

Figure 1 North eastern Atlantic showing the Porcupine bank, Porcupine Seabight, and ICES divisions.

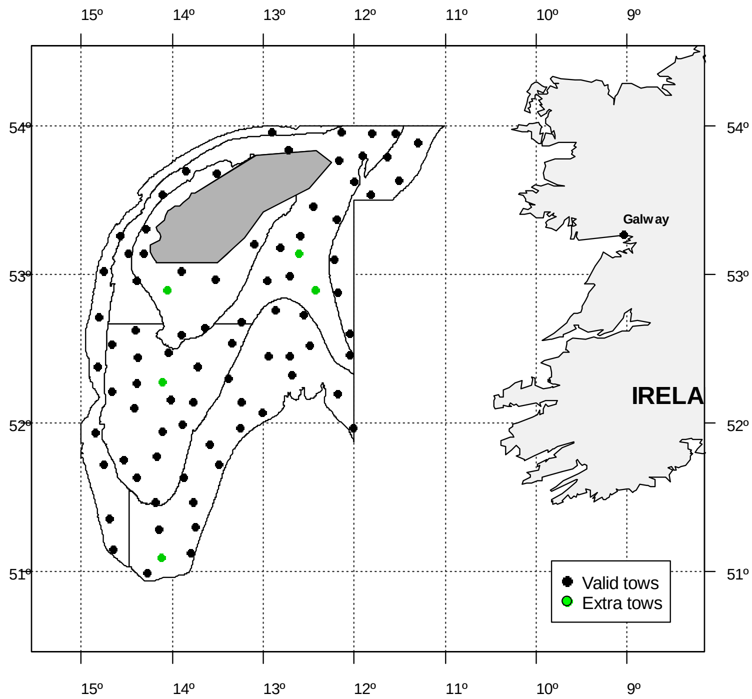

Figure 2 Stratification design and hauls in 2014 Porcupine surveys; Straight lines show geographical sectors (North and South) and the isobaths delimit the three depth strata (> 300 m, 300 – 450 m and 450 - 800 m).

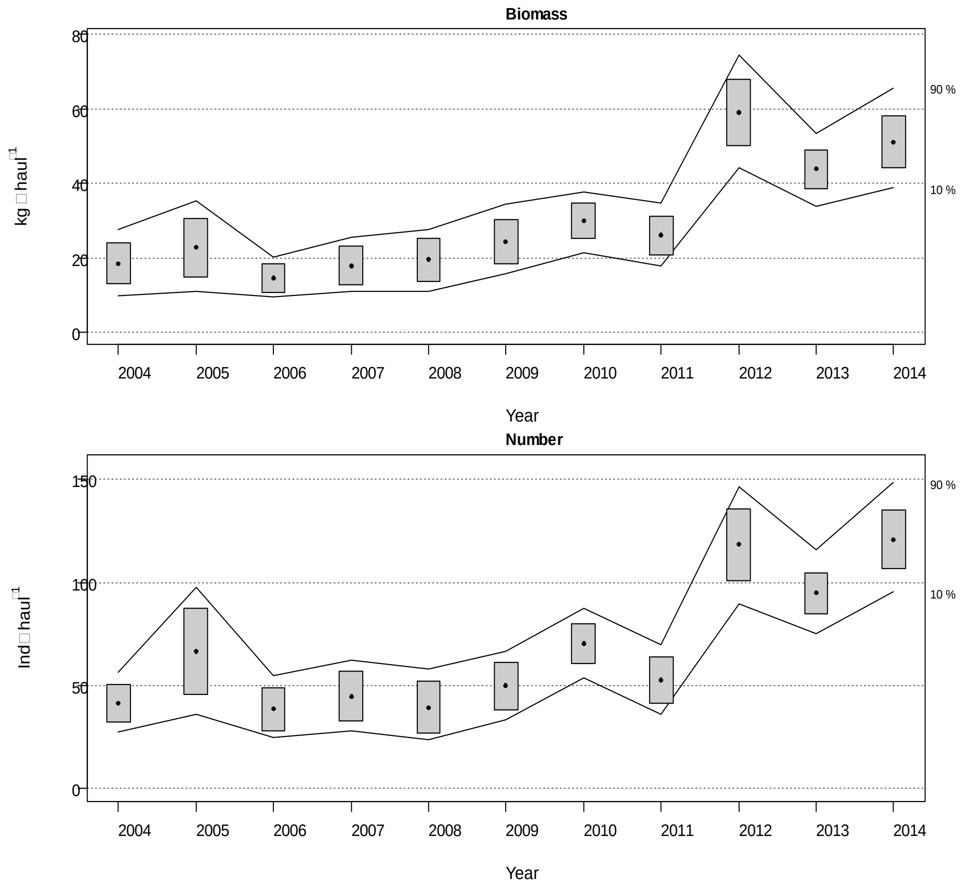

Figure 3 Changes in *Galeus melastomus* biomass index and abundance during Porcupine survey time series since 2004, when data have been reviewed with the haul duration (2004-2014). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

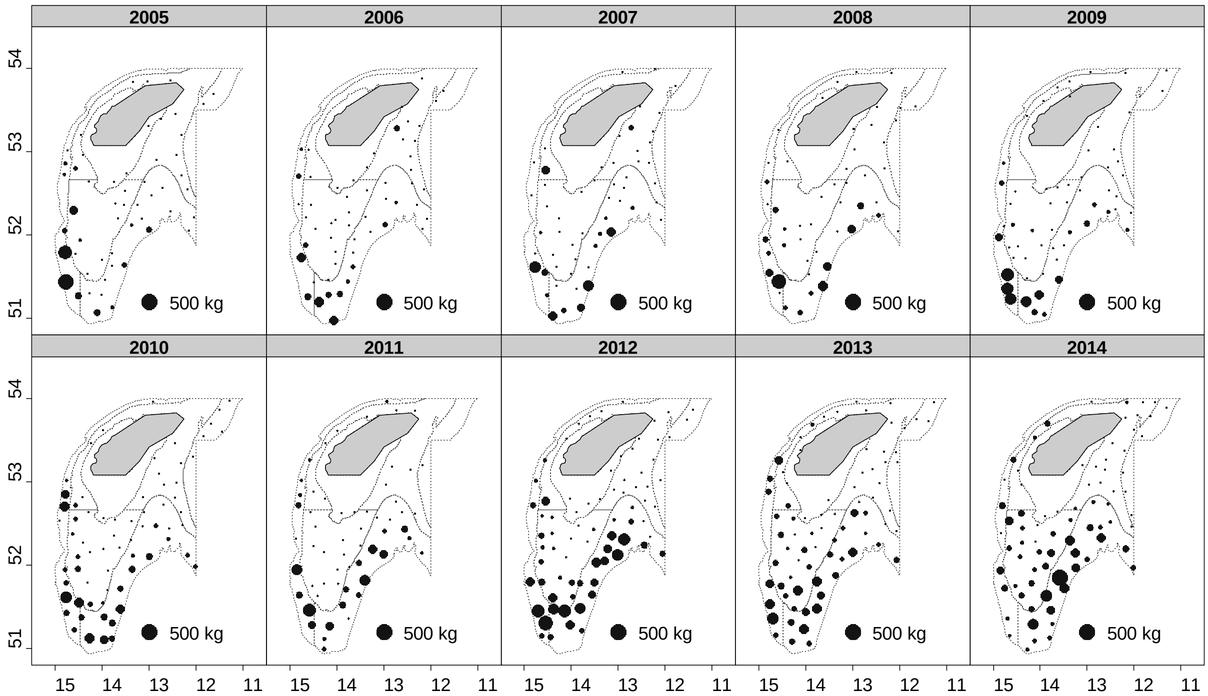

Figure 4 Geographic distribution of *Galeus melastomus* catches (kg·haul^{-1}) during Porcupine survey time series (2005- 2014).

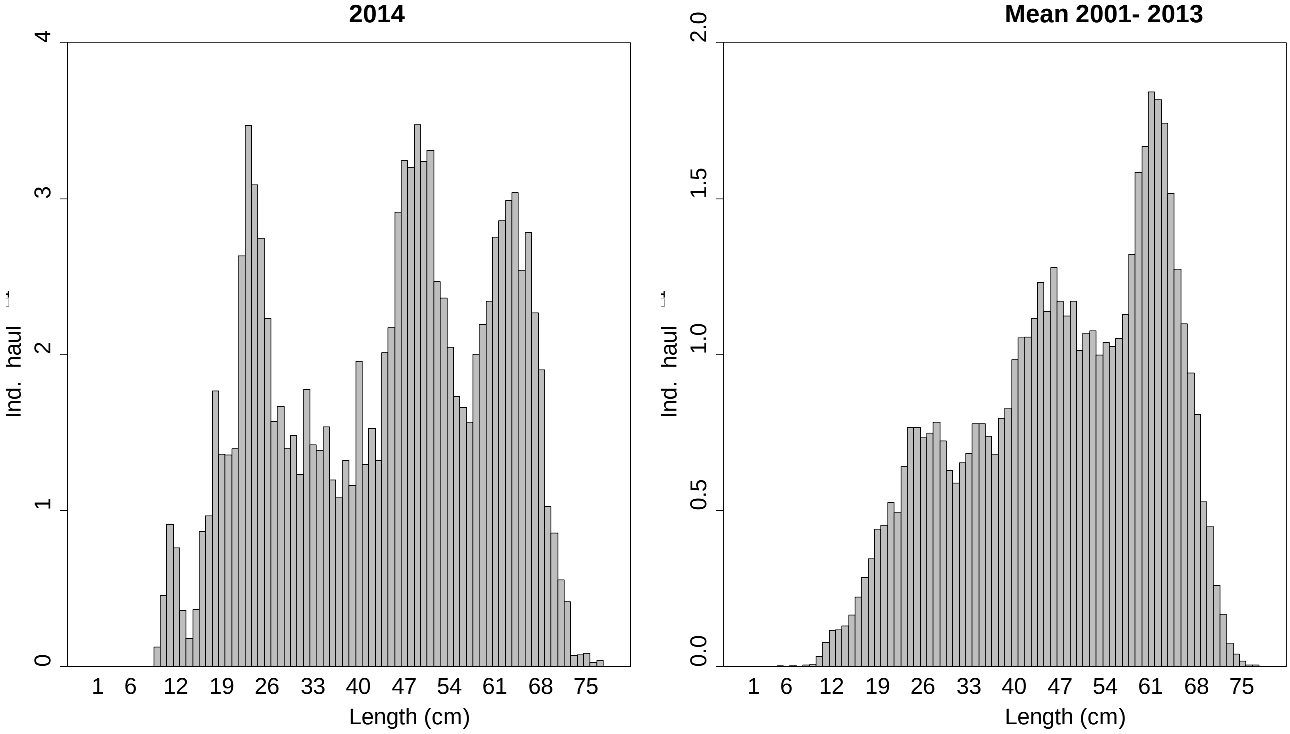

Figure 5 Stratified length distributions of *Galeus melastomus* in 2014 Porcupine survey, and mean values during Porcupine survey time series (2001-2013).

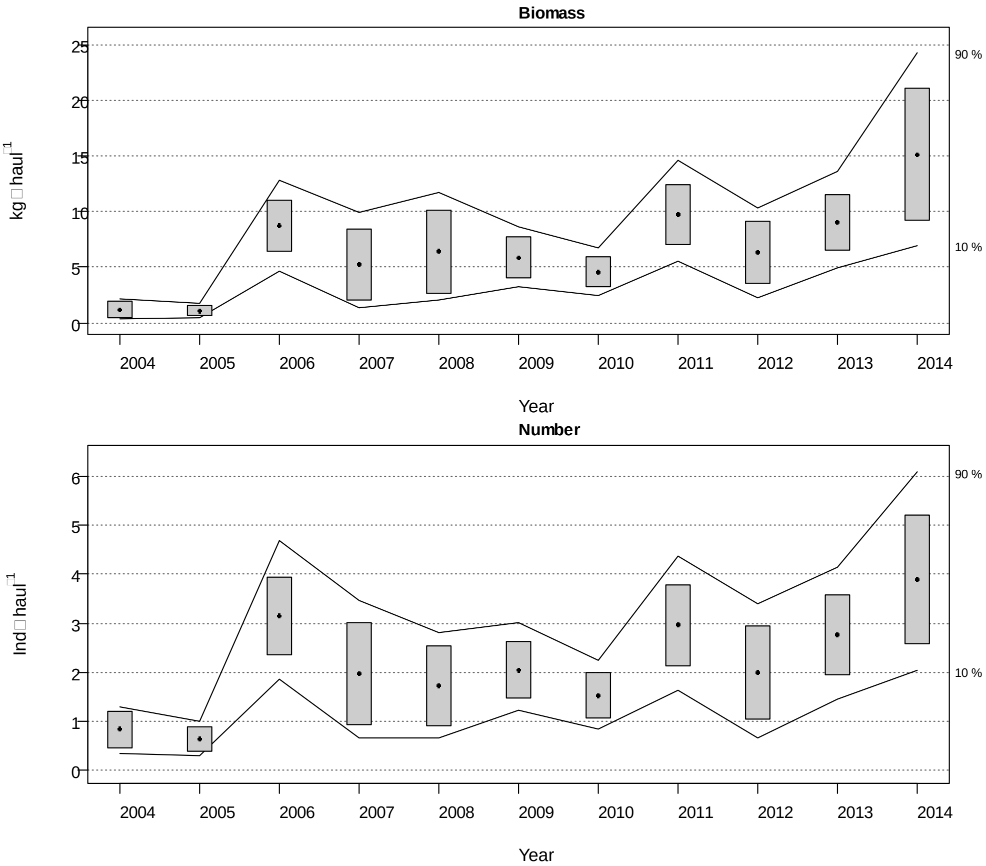

Figure 6 Changes in *Deania calcea* biomass index (kg·haul^{-1}) during Porcupine survey time series since 2004, when data have been reviewed with the haul duration (2004-2014). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000).

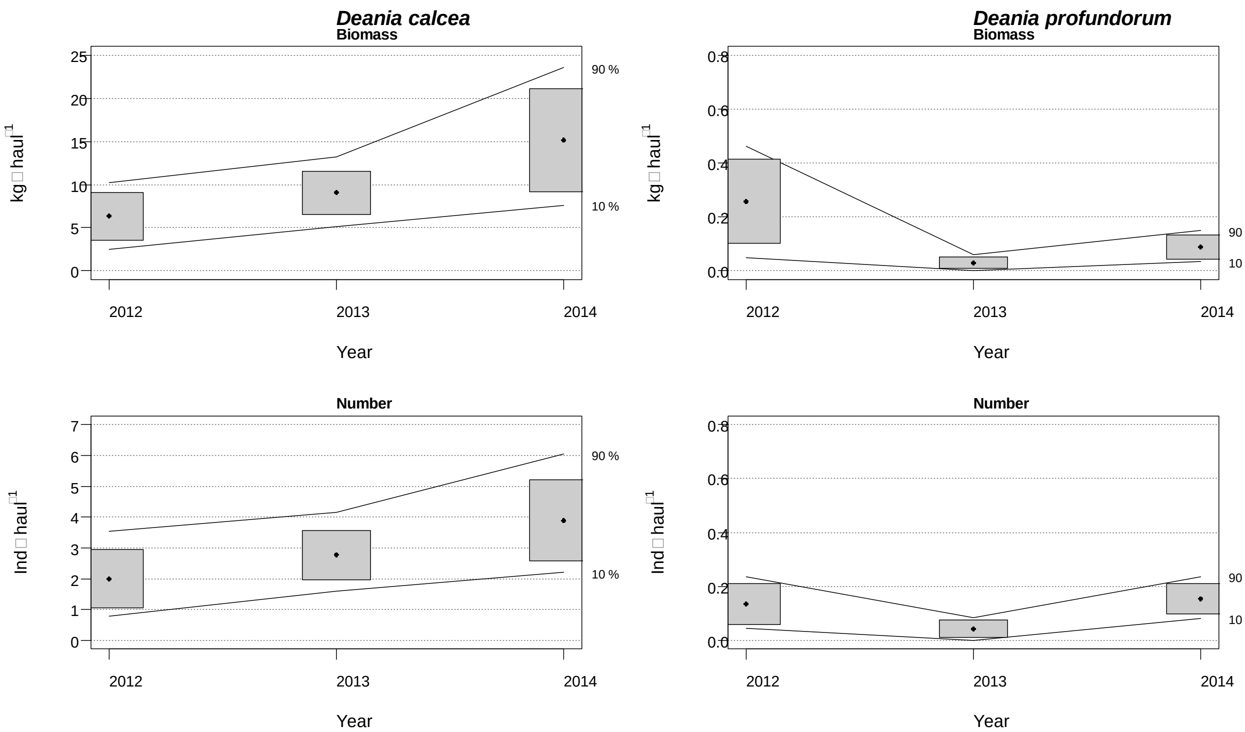

Figure 7 Changes in *Deania calcea* and *Deania profundorum* biomass index (kg·haul^{-1}) in 2012 and 2014 Porcupine surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000).

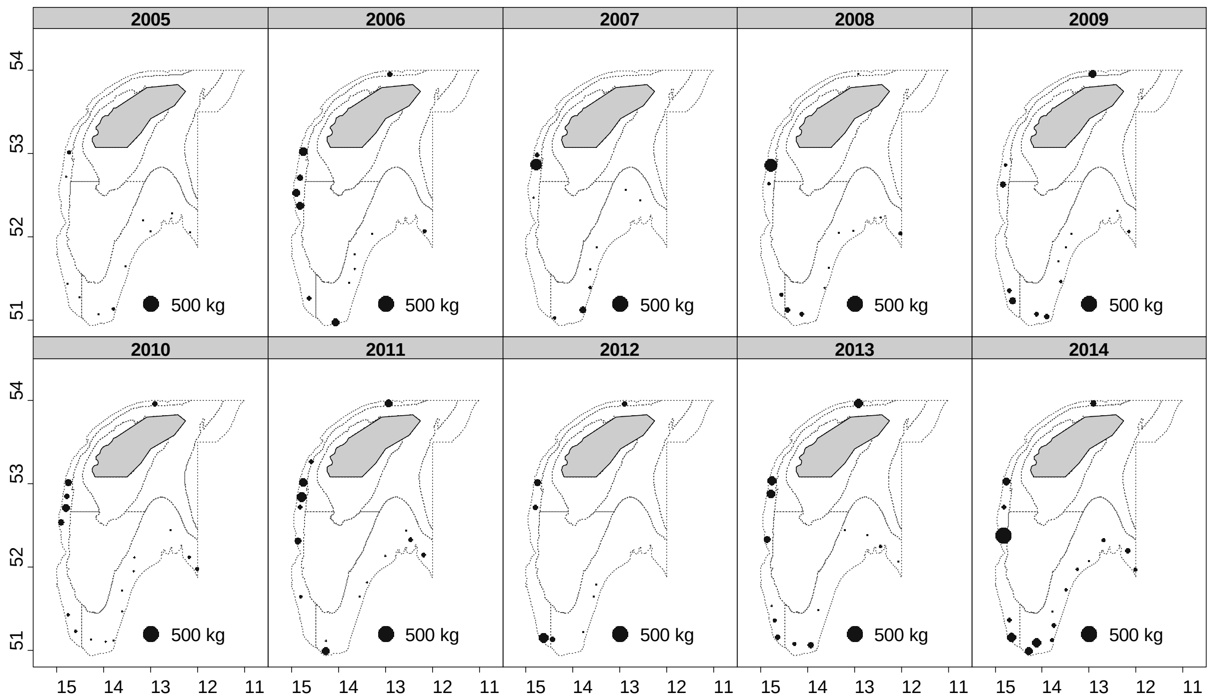

Figure 8 Geographic distribution of *Deania calcea* catches (kg·haul^{-1}) during Porcupine survey time series (2005- 2014).

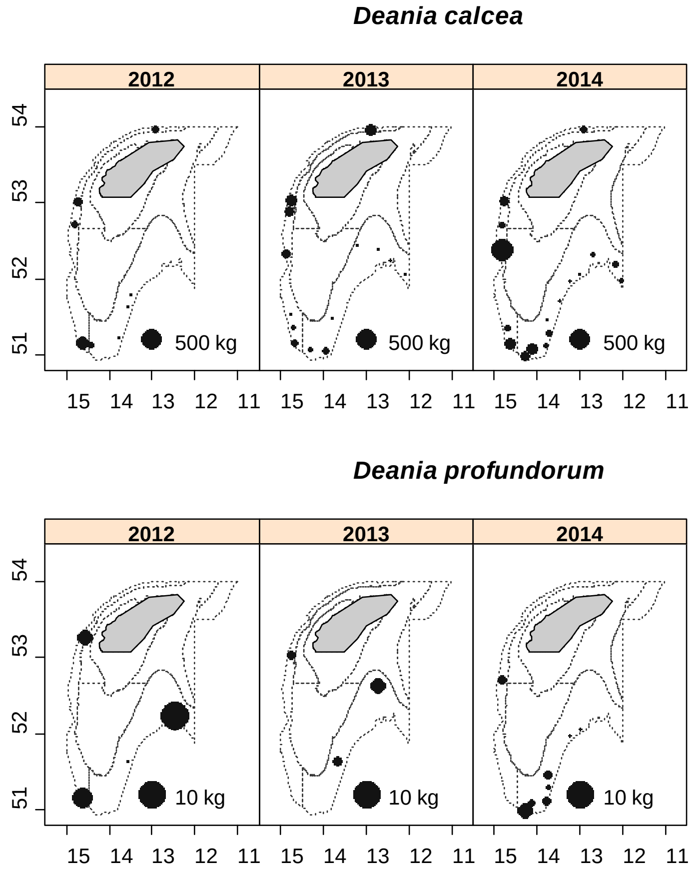

Figure 9 Geographic distribution of *Deania calcea* and *Deania profundorum* catches (kg·haul^{-1}) 2012 and 2014 Porcupine surveys.

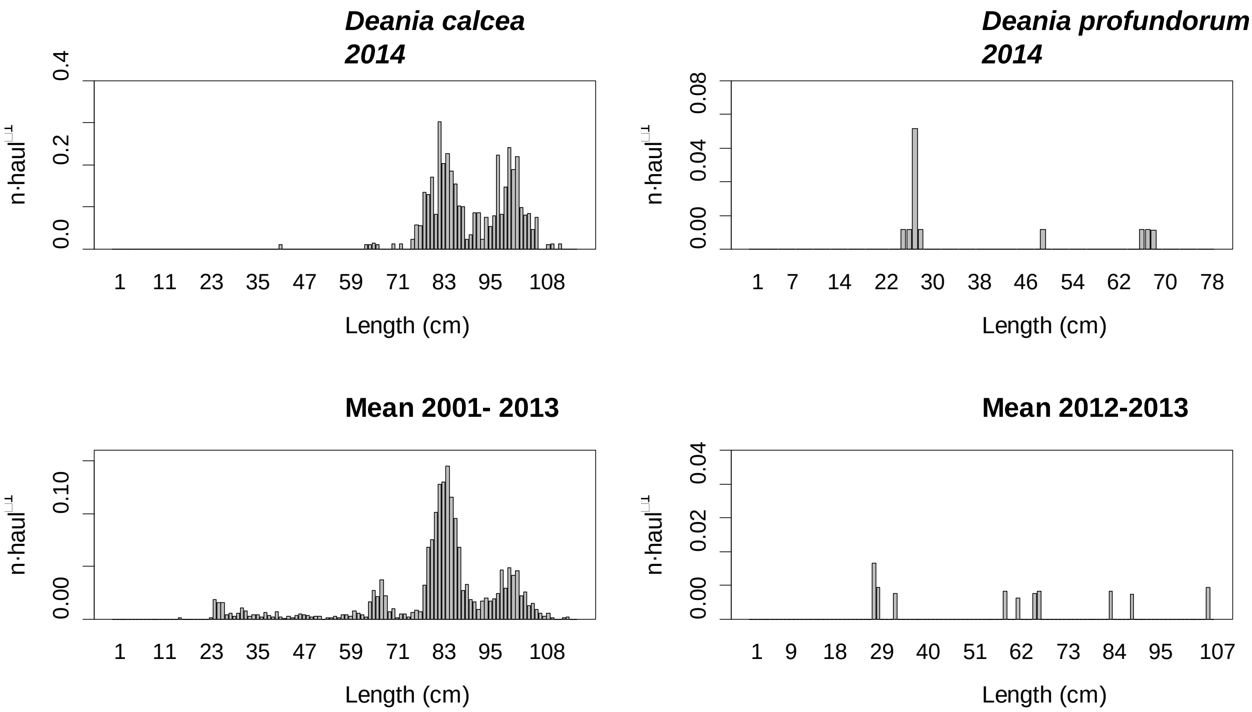

Figure 10 Stratified length distribution of *Deania calcea* and *Deania profundorum* in 2014 compared with mean values along Porcupine surveys 2001 and 2013 for *D. Calcea* and mean values along 2012 and 2013 for *D. profundorum.*

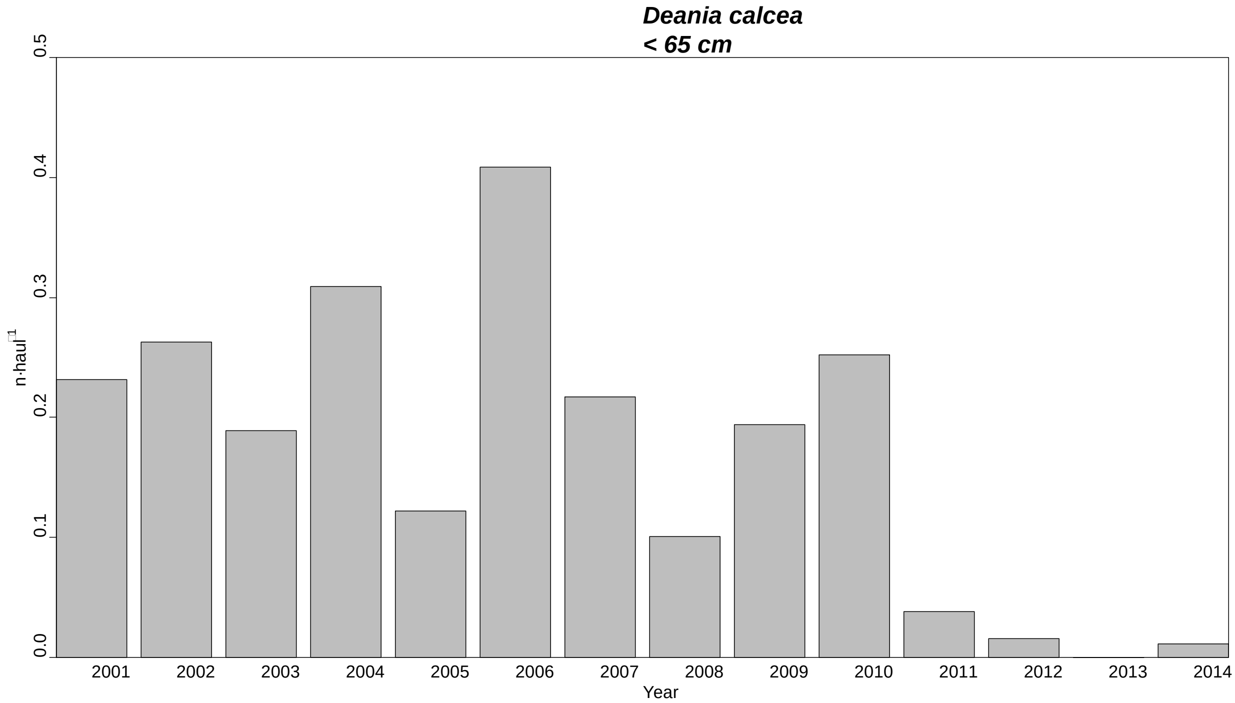

Figure 11 Abundance of *Deania calcea* smaller than 65 cm during Porcupine survey time series (2001-2014). It is important to note that the two species of the genus Deania were recorded together as D.calcea before 2012.

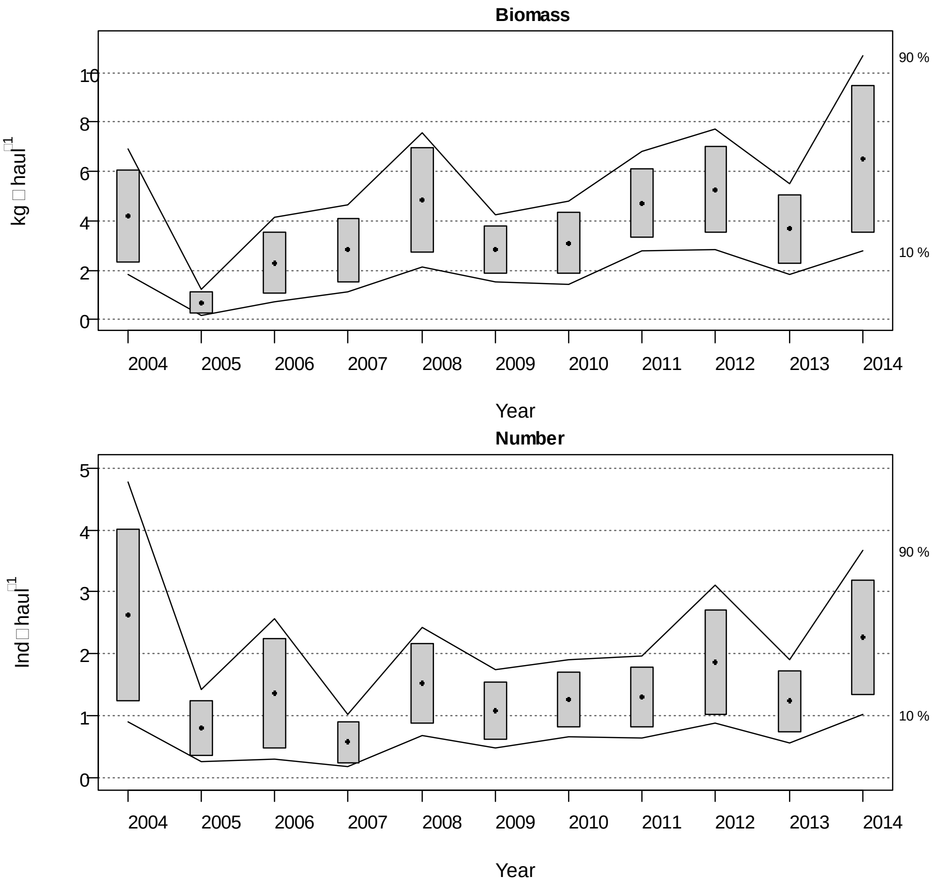

Figure 12 Changes in *Scymnodon ringens* biomass index (kg·haul^{-1}) during Porcupine survey time series since 2004, when data have been reviewed with the haul duration (2004-2014). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

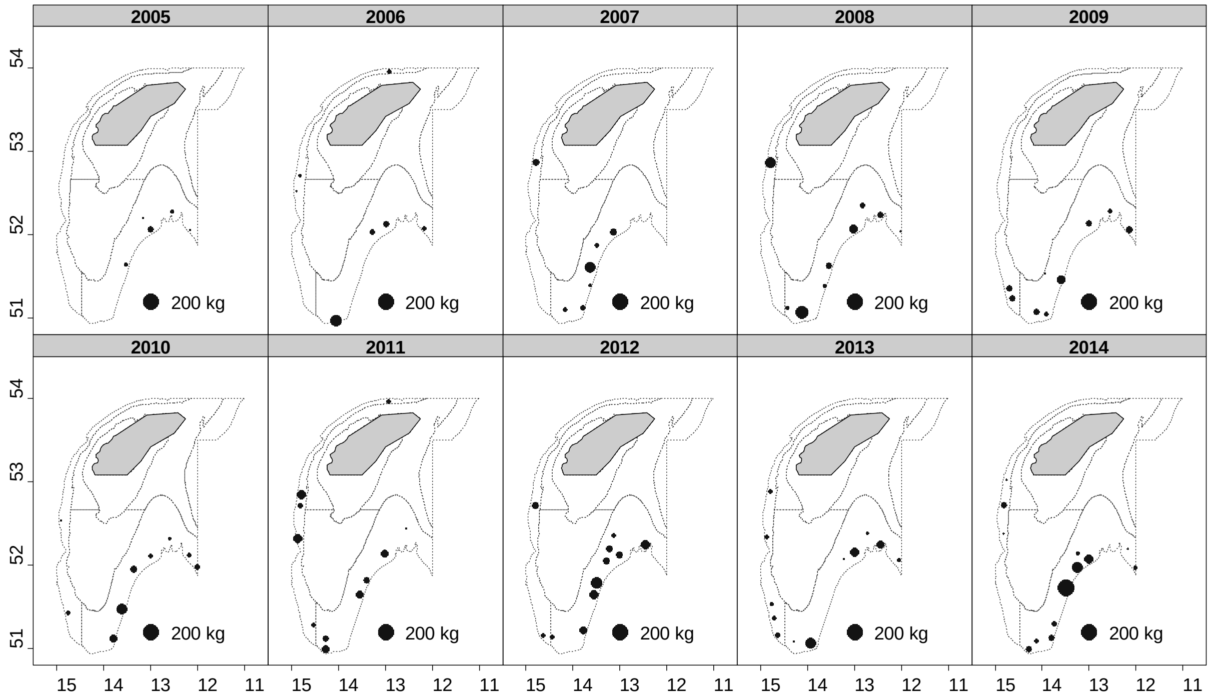

Figure 13 Geographic distribution of *Scymnodon ringens* catches (kg·haul^{-1}) in Porcupine survey time series (2005-2014).

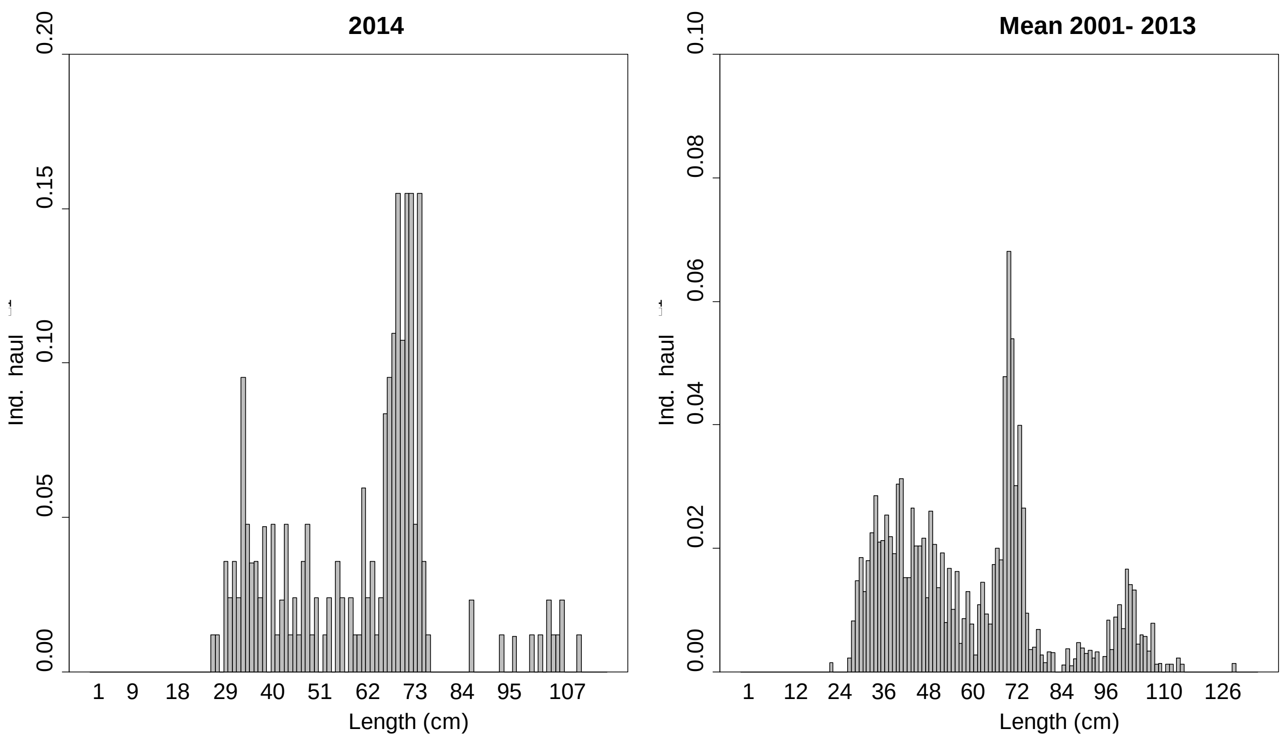

Figure 14 Stratified length distributions of *Scymnodon ringens* in 2014 in Porcupine survey, and mean values during Porcupine survey time series (2001-2013).

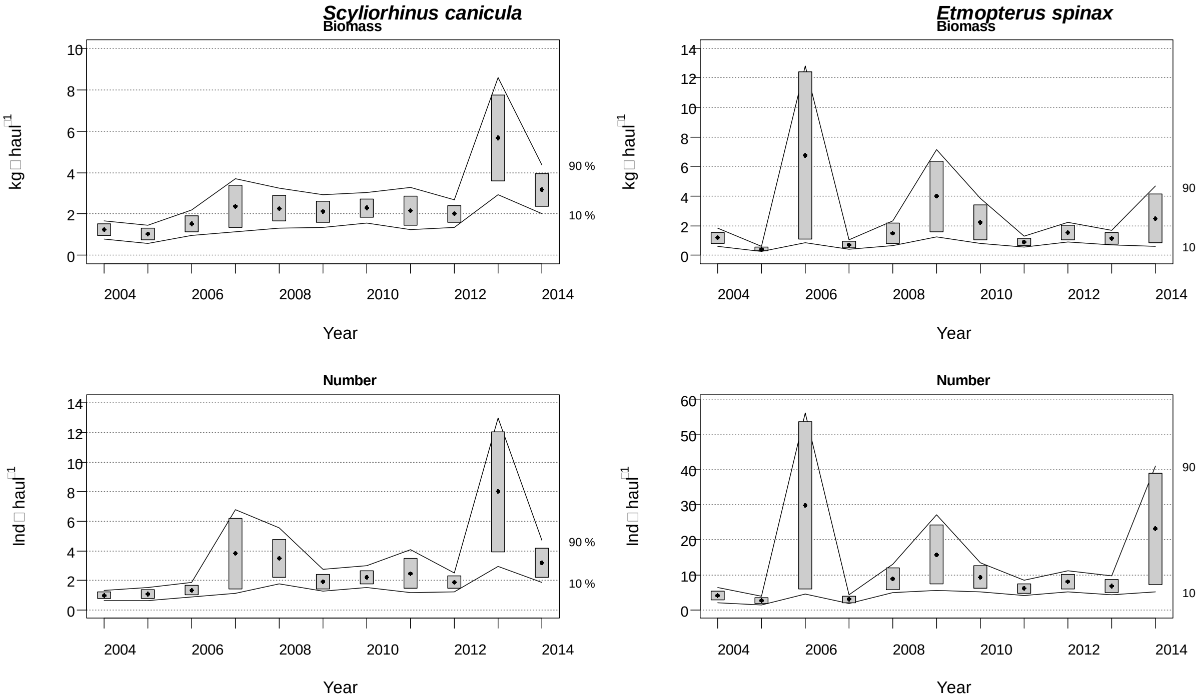

Figure 15 Changes in *Scyliorhinus cannicula* and *Etmopterus spinax* biomass index (kg·haul^{-1}) during Porcupine survey time series since 2004, when data have been reviewed with the haul duration (2004-2014). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

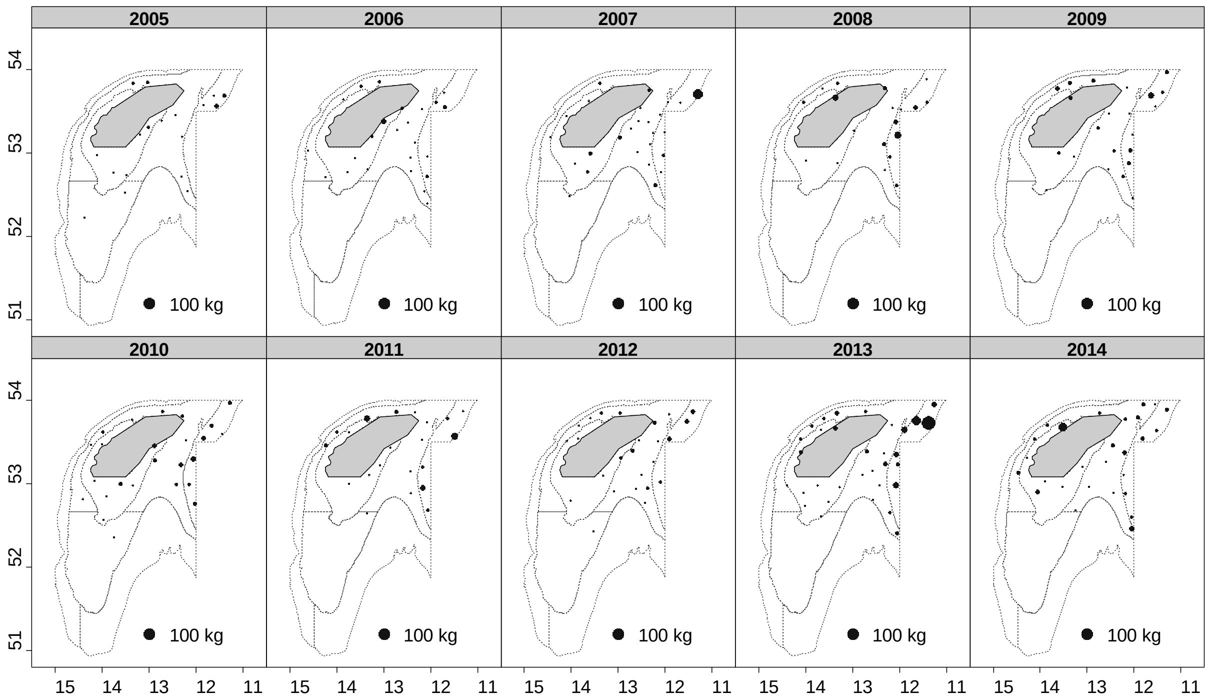

Figure 16 Geographic distribution of *Scyliorhinus cannicula* catches (kg·haul^{-1}) during Porcupine survey time series (2005- 2014).

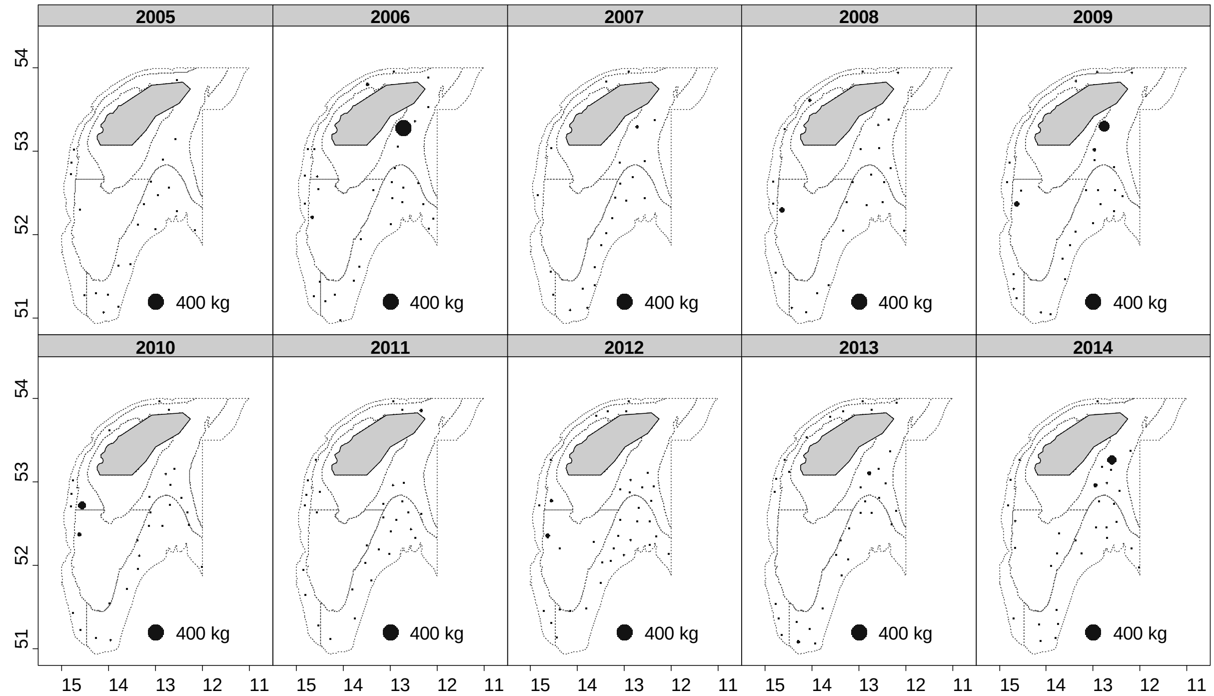

Figure 17 Geographic distribution of *Etmopterus spinax* catches (kg·haul^{-1}) during Porcupine surveys time series (2005- 2014).

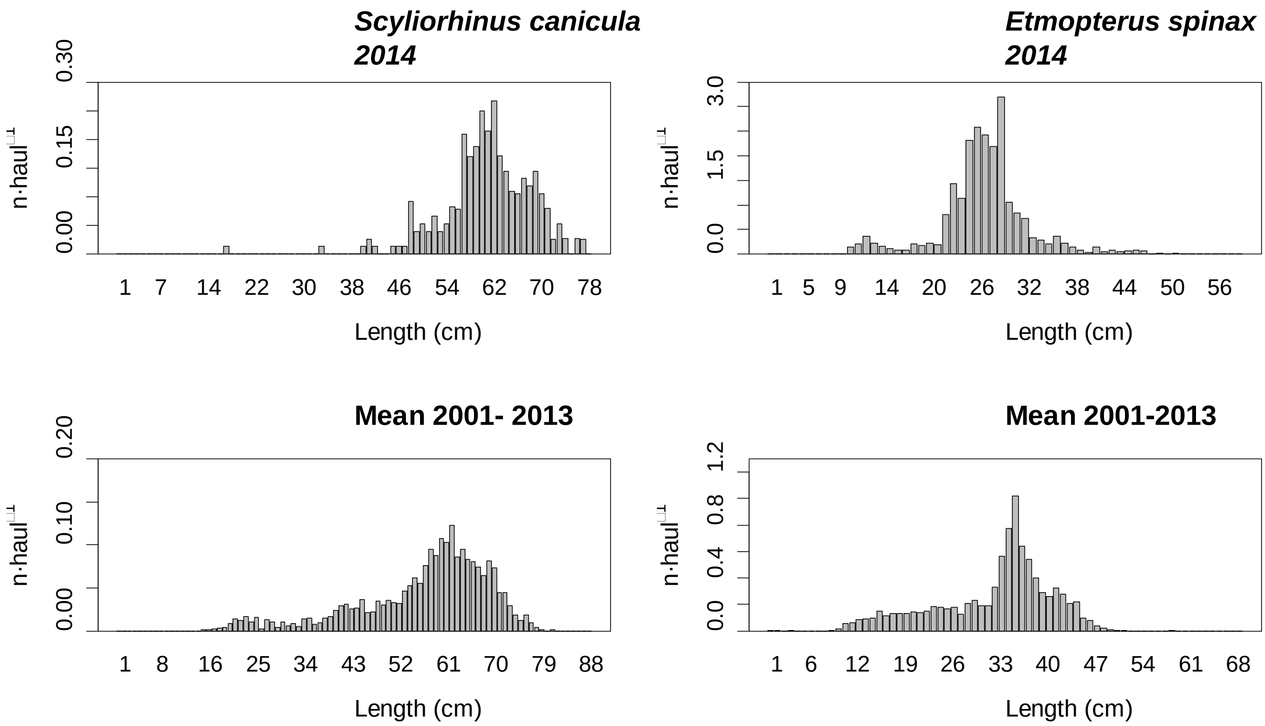

Figure 18 Stratified length distribution of *Scyliorhinus canicula* in 2014 in Porcupine survey, and mean values during Porcupine survey time series (2001-2013) compared with Stratified length distribution of *Etmopterus spinax* in 2014 in Porcupine survey, and mean values during Porcupine survey time series (2001-2013).

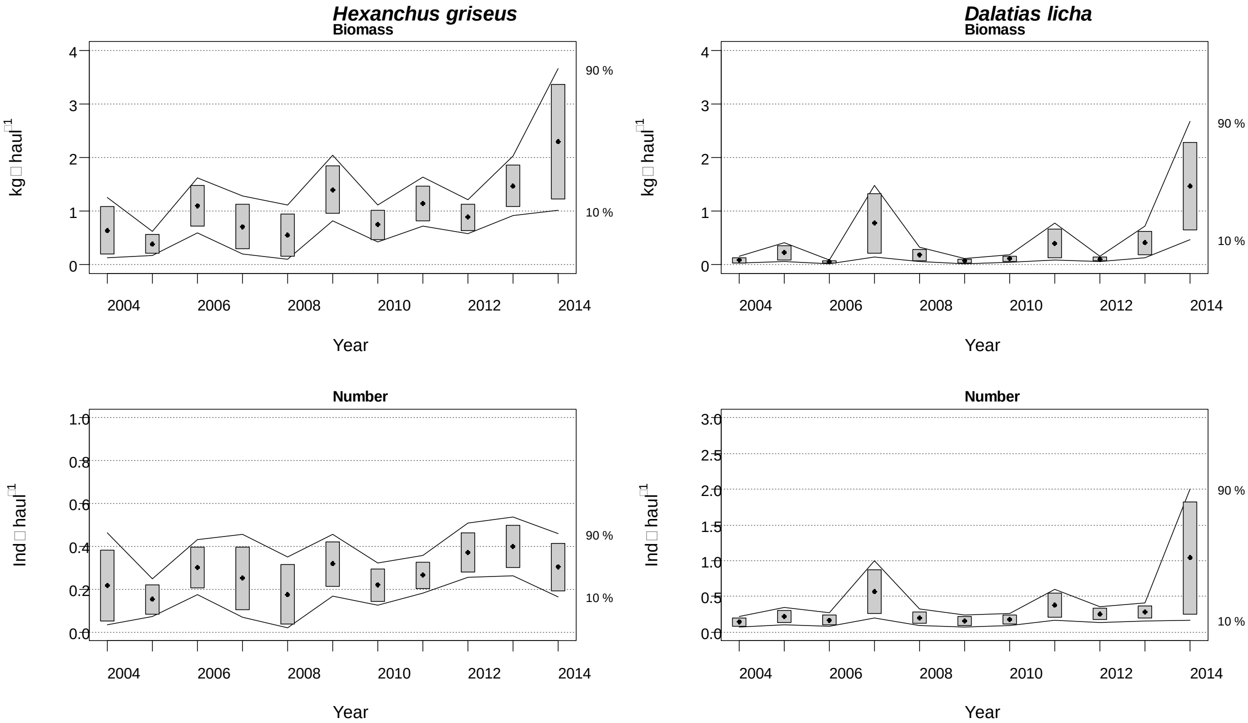

Figure 19 Changes in *Hexanchus griseus* and *Dalatias licha* biomass index (kg·haul^{-1}) during Porcupine survey time series since 2004, when data have been reviewed with the haul duration (2004-2014). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

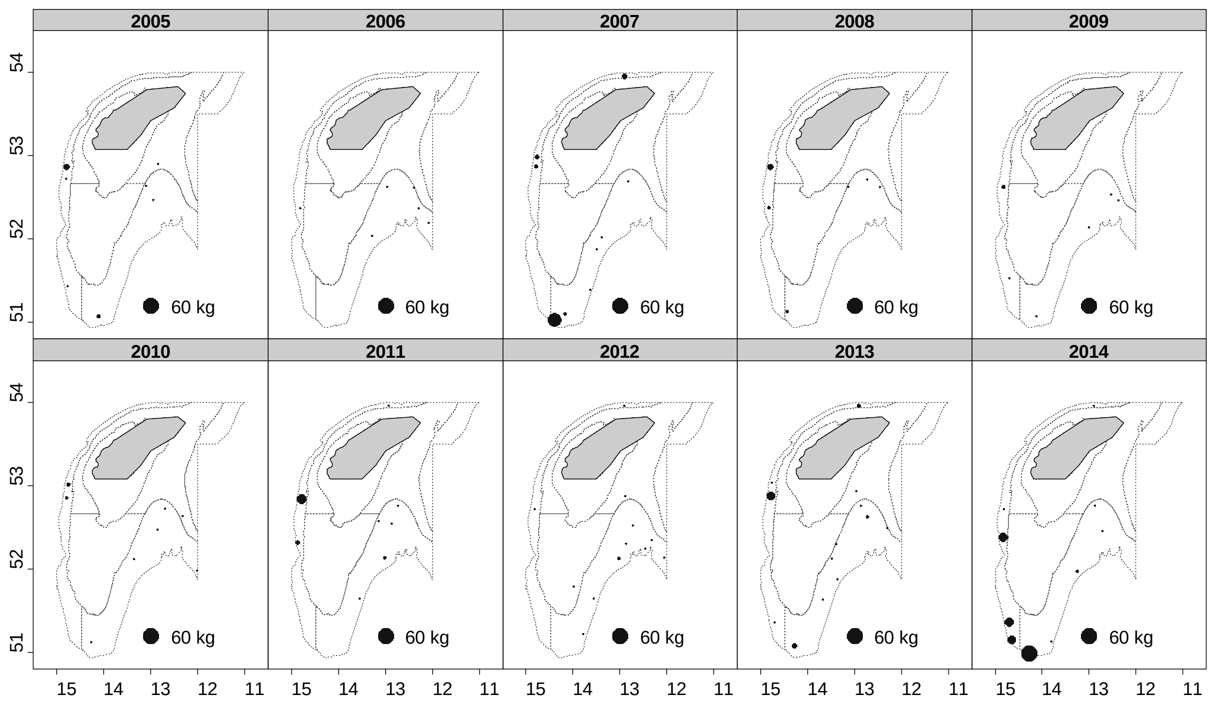

Figure 20 Geographic distribution of *Dalatias licha* catches (kg·haul^{-1}) during Porcupine surveys time series (2005- 2014).

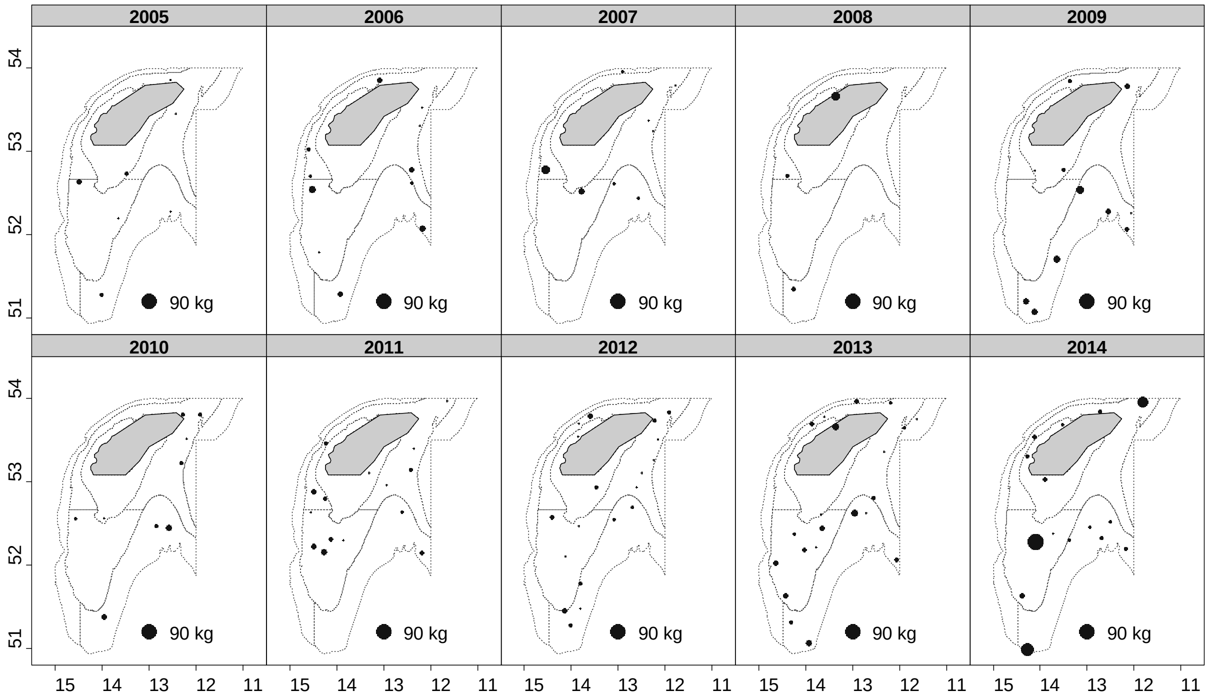

Figure 21 Geographic distribution of *Hexanchus griseus* catches (kg·haul^{-1}) during Porcupine surveys time series (2005- 2014).

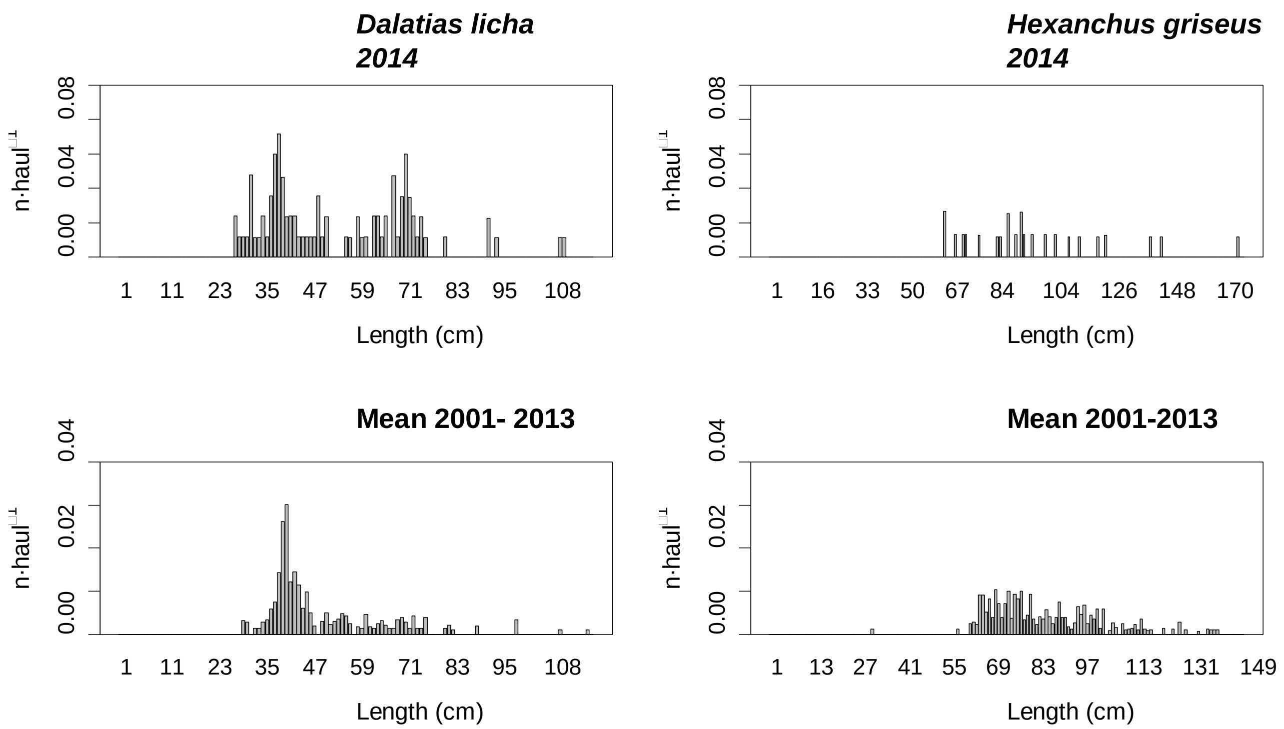

Figure 22 Stratified length distributions of *Dalatias licha* in 2014 Porcupine survey, and mean values during Porcupine survey time series (2001-2013) compared with Stratified length distributions of *Hexanchus griseus* in 2014 Porcupine survey, and mean values during Porcupine survey time series (2001-2013).

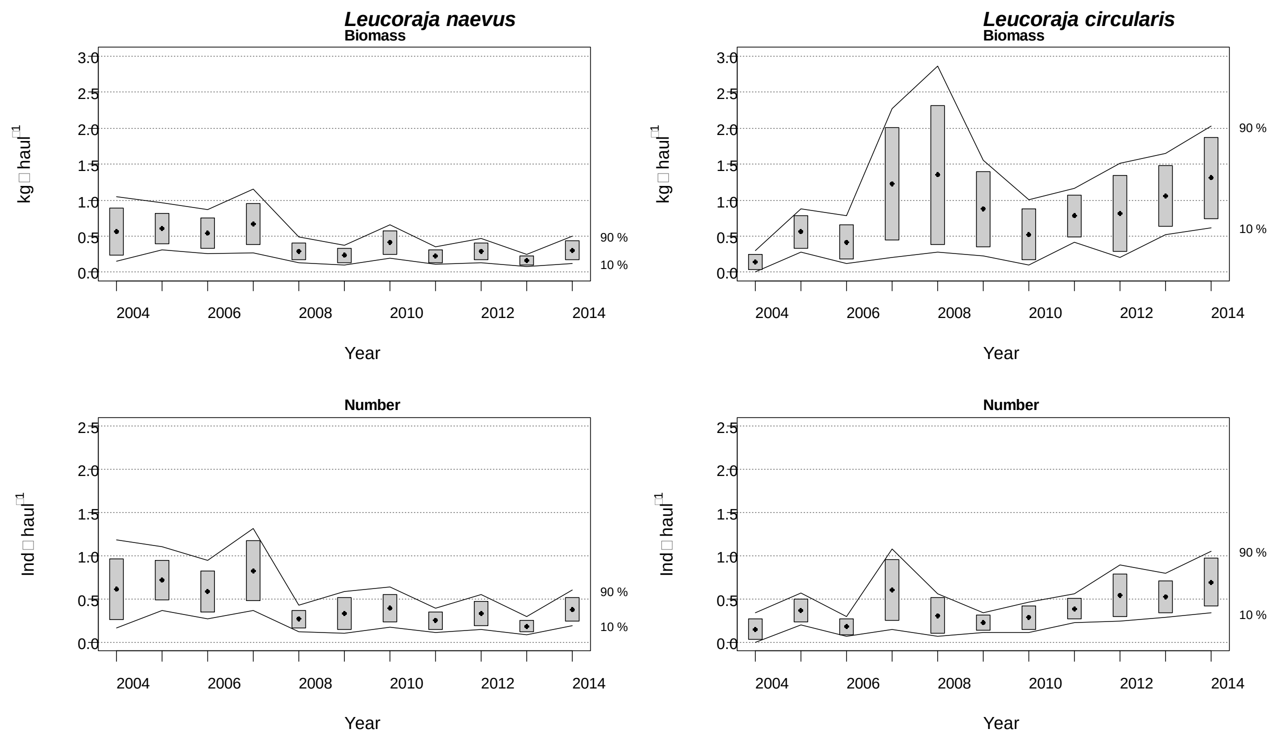

Figure 23 Changes in *Leucoraja naevus* and *Leucoraja circularis* biomass index (kg·haul^{-1}) during Porcupine survey time series since 2004, when data have been reviewed with the haul duration (2004-2014). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000).

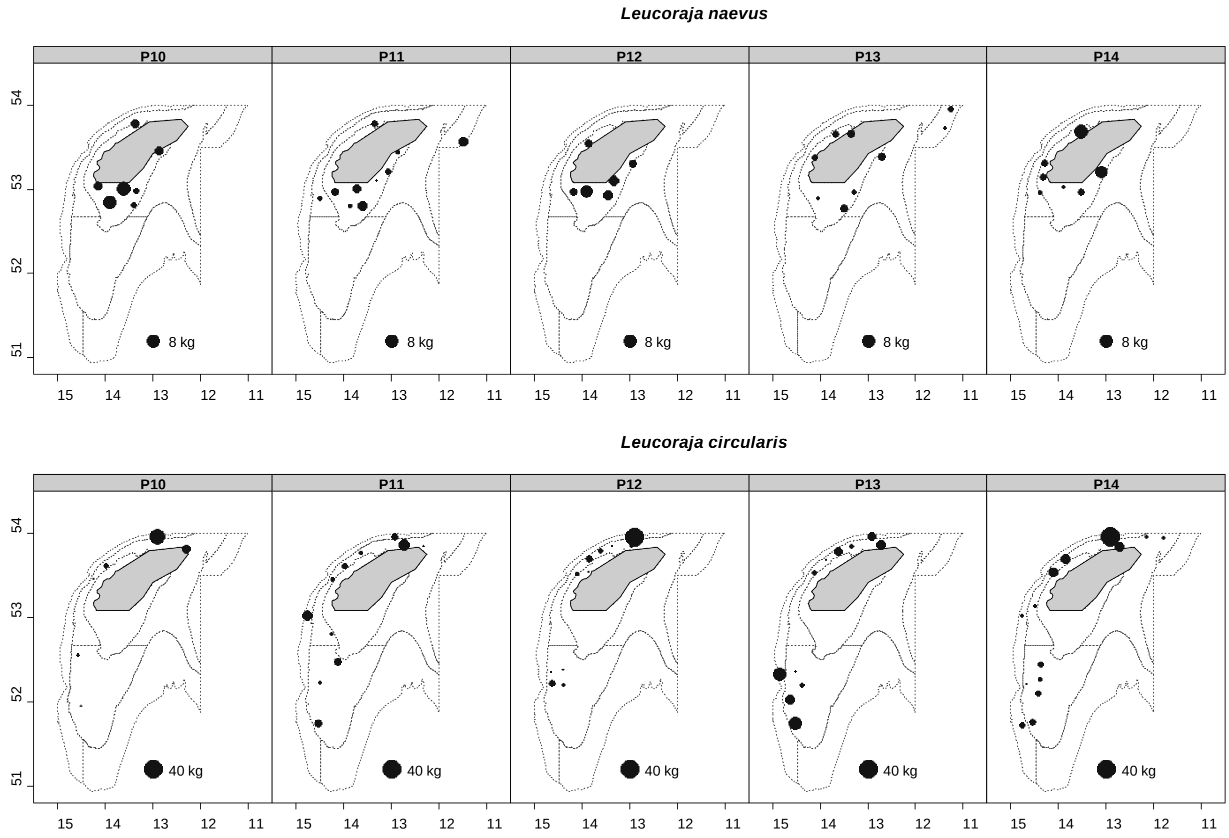

Figure 24 Geographic distribution of *Leucoraja naevus* and *Leucoraja circularis* catches (kg·haul^{-1}) in Porcupine survey time series (2010-2014).

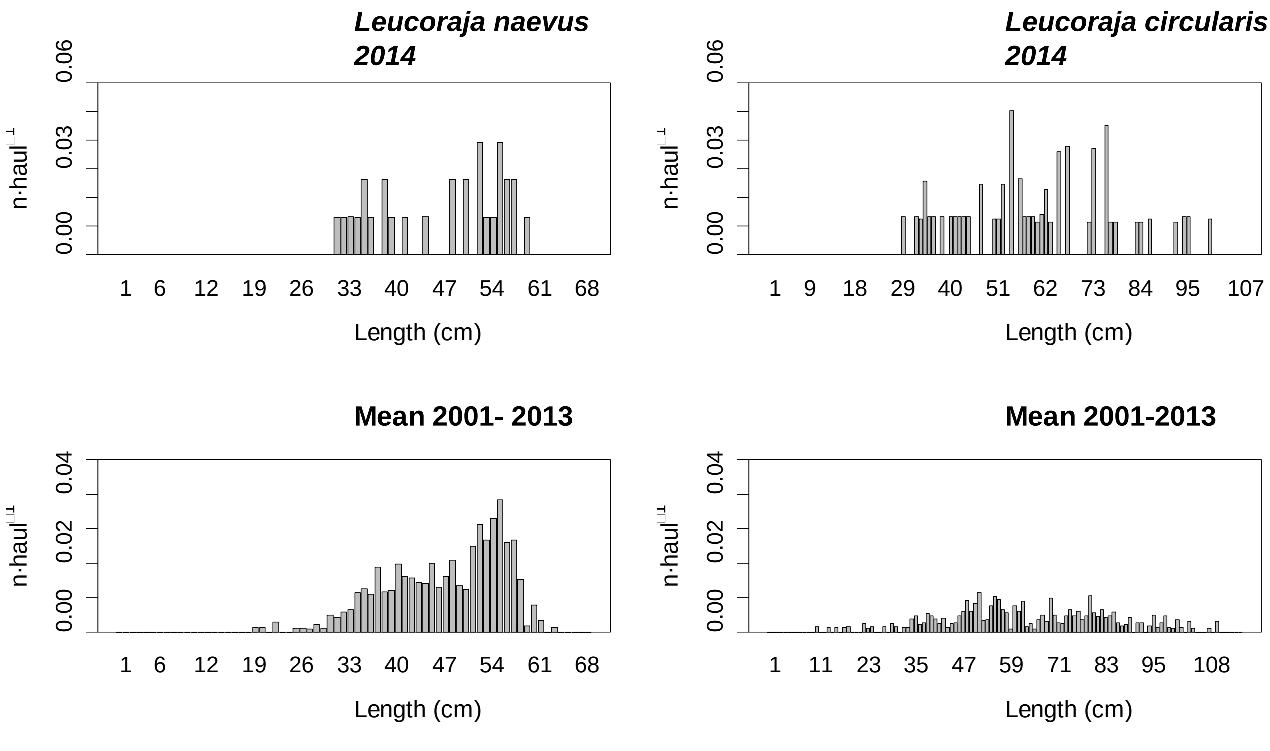

Figure 25 Stratified length distributions of *Leucoraja naevus* and *Leucoraja circularis* in 2014 Porcupine survey, and mean values during Porcupine survey time series (2001-2013).

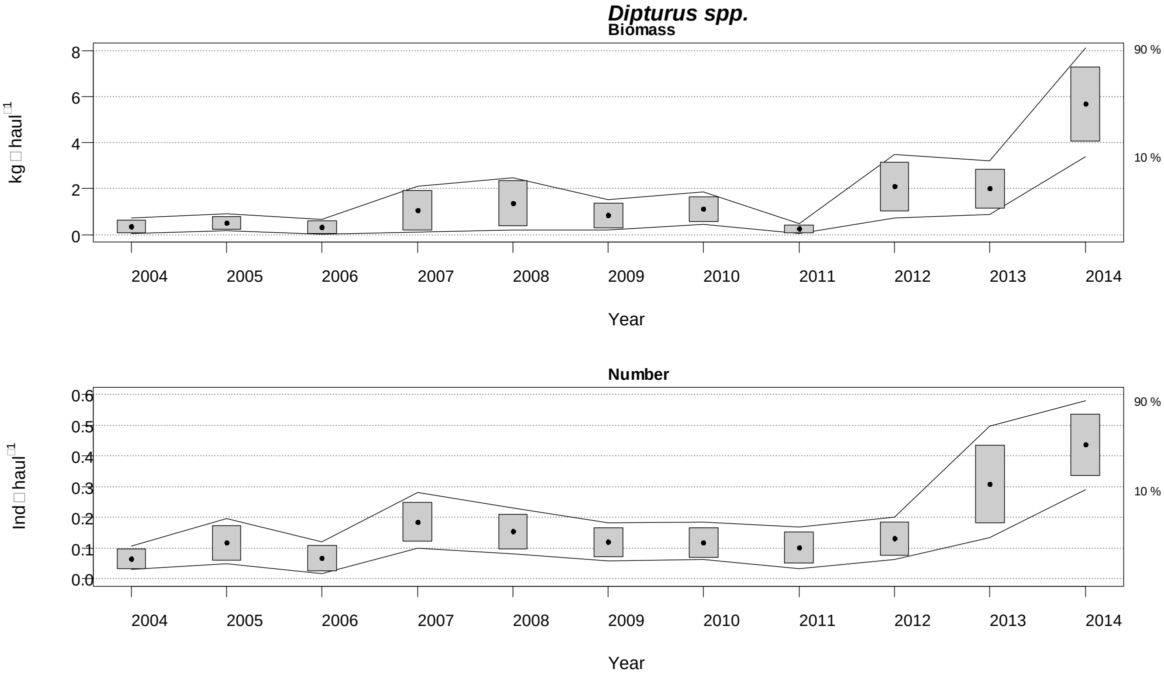

Figure 26 Changes in *Dipturus* spp. biomass index (kg.haul^{-1}) during Porcupine survey time series since 2004, when data have been reviewed with the haul duration (2004-2014). Boxes mark parametric standard error of the stratified index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

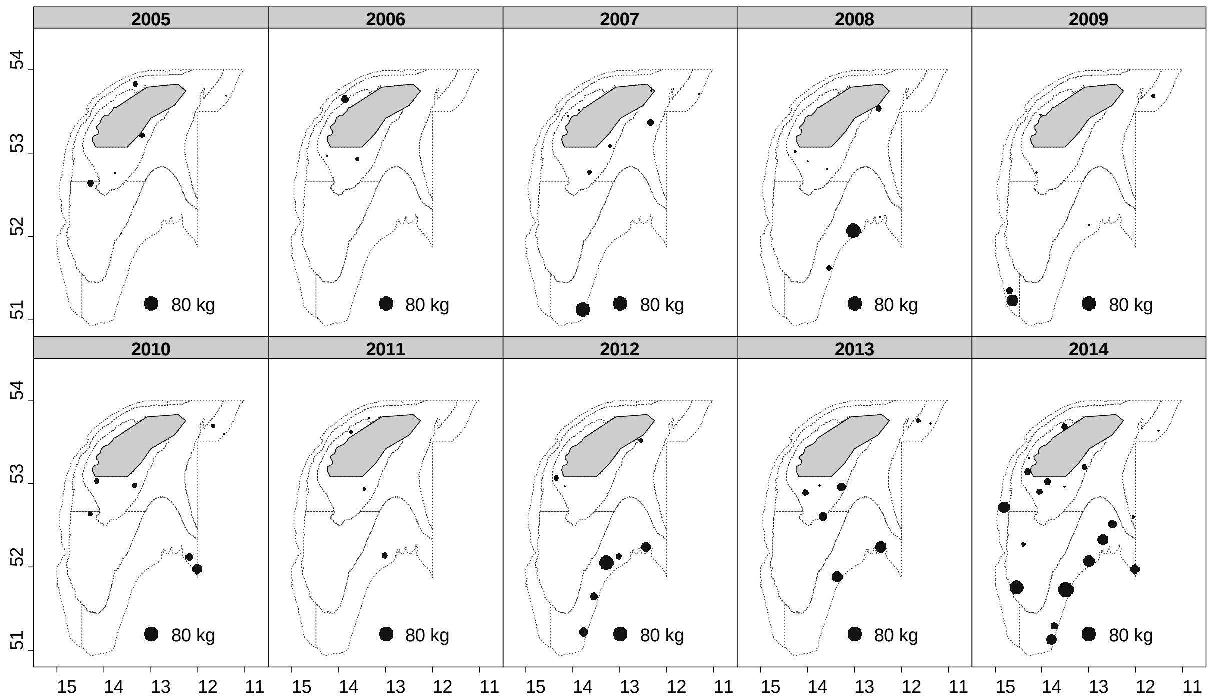

Figure 27 Geographic distribution of *Dipturus* spp. catches (Kg· haul^{-1}) in Porcupine survey time series (2005-2014).

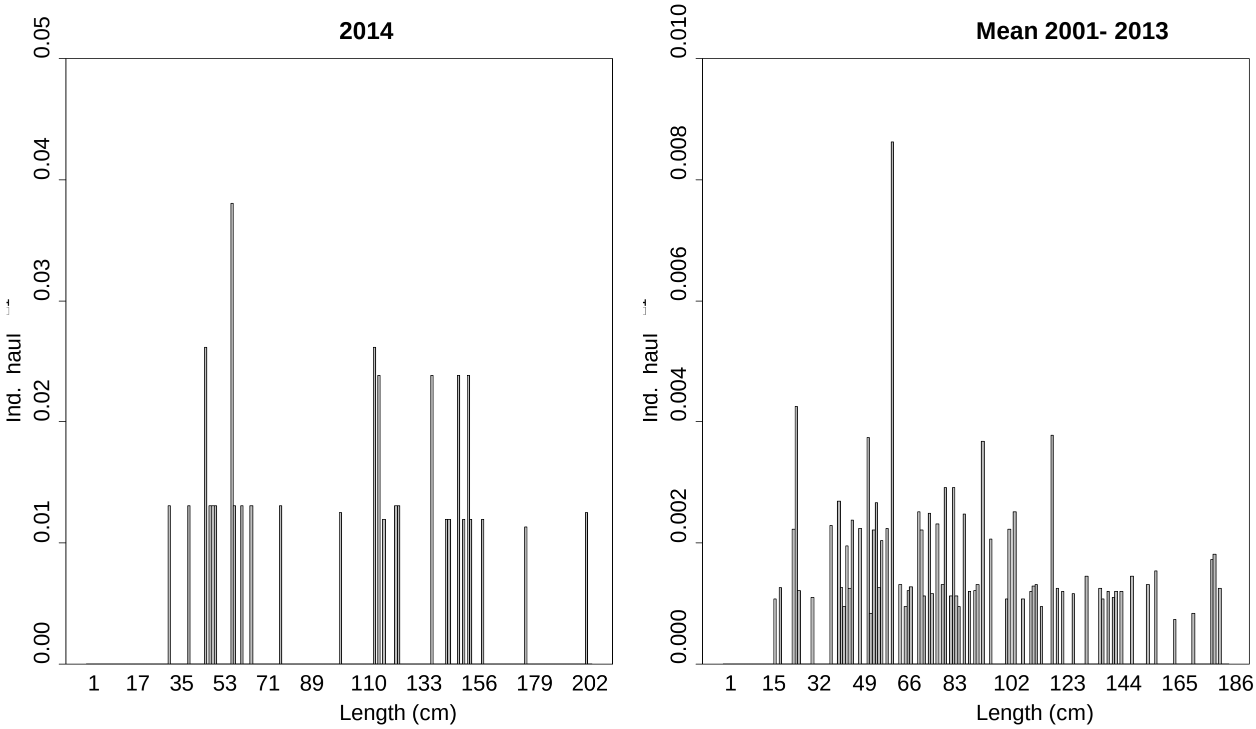

Figure 28 Stratified length distributions of *Dipturus* spp. in 2014 Porcupine survey, and mean values during Porcupine survey time series (2001-2013).

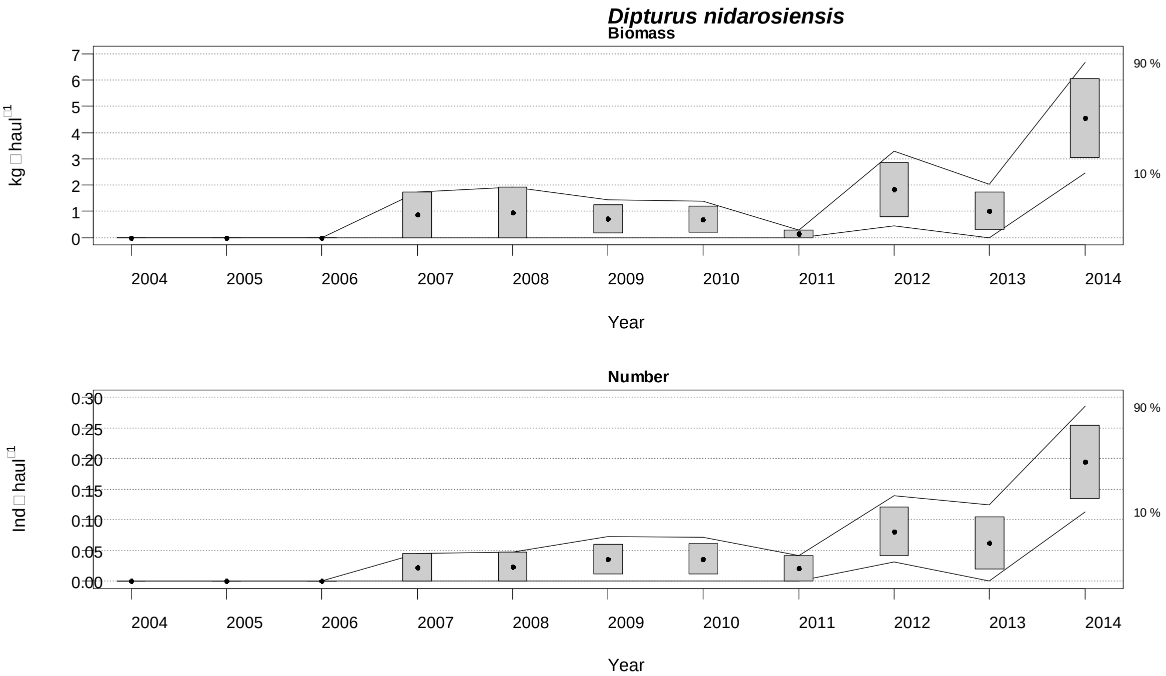

Figure 29 Changes in *Dipturus nidarosiensis* biomass index (kg·haul^{-1}) during Porcupine survey time series since 2004, when data have been reviewed with the haul duration (2004-2014). Boxes mark parametric standard error of the stratified index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

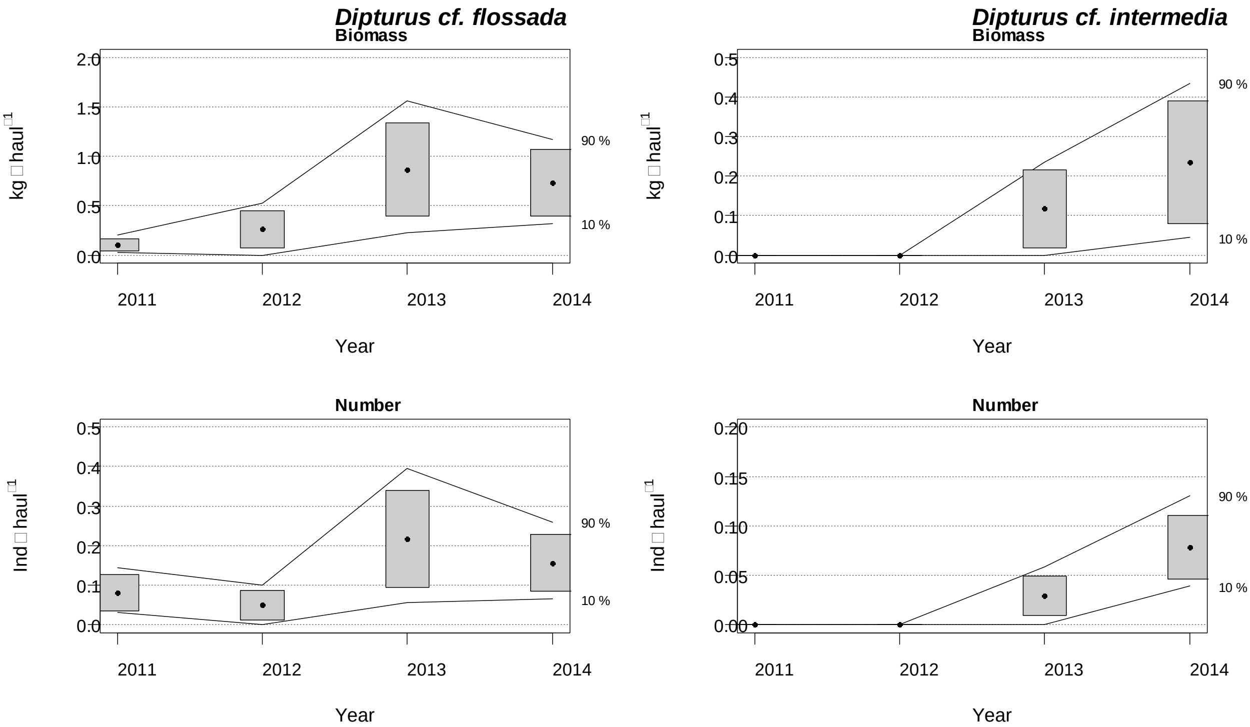

Figure 30 Changes in *Dipturus cf. flossada* and *Dipturus cf. intermedia*. biomass index (kg·haul^{-1}) during Porcupine survey time series (2011-2014). Boxes mark parametric standard error of the stratified index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

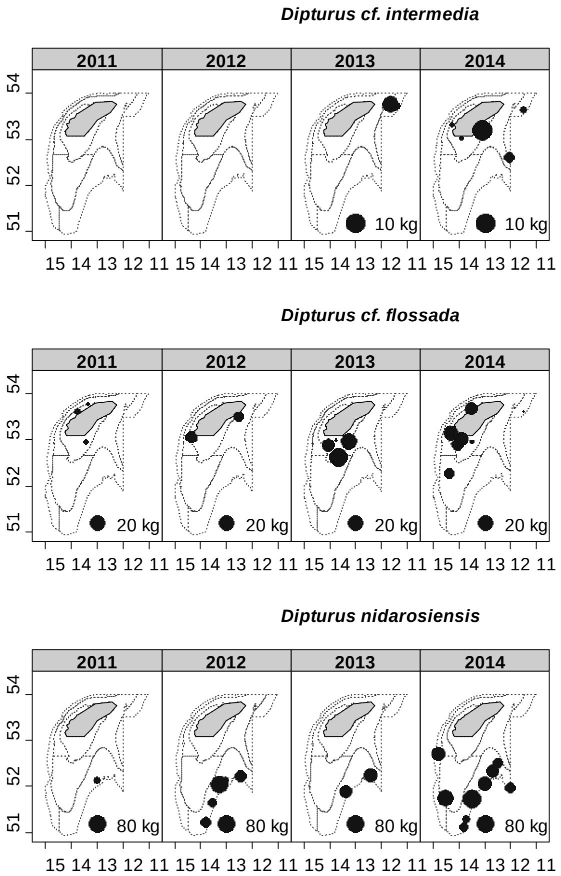

Figure 31 Geographic distribution of *Dipturus nidarosiensis*, *Dipturus cf. flossada* and *Dipturus cf. intermedia* catches (kg·haul^{-1}) in Porcupine survey between 2011 and 2014.

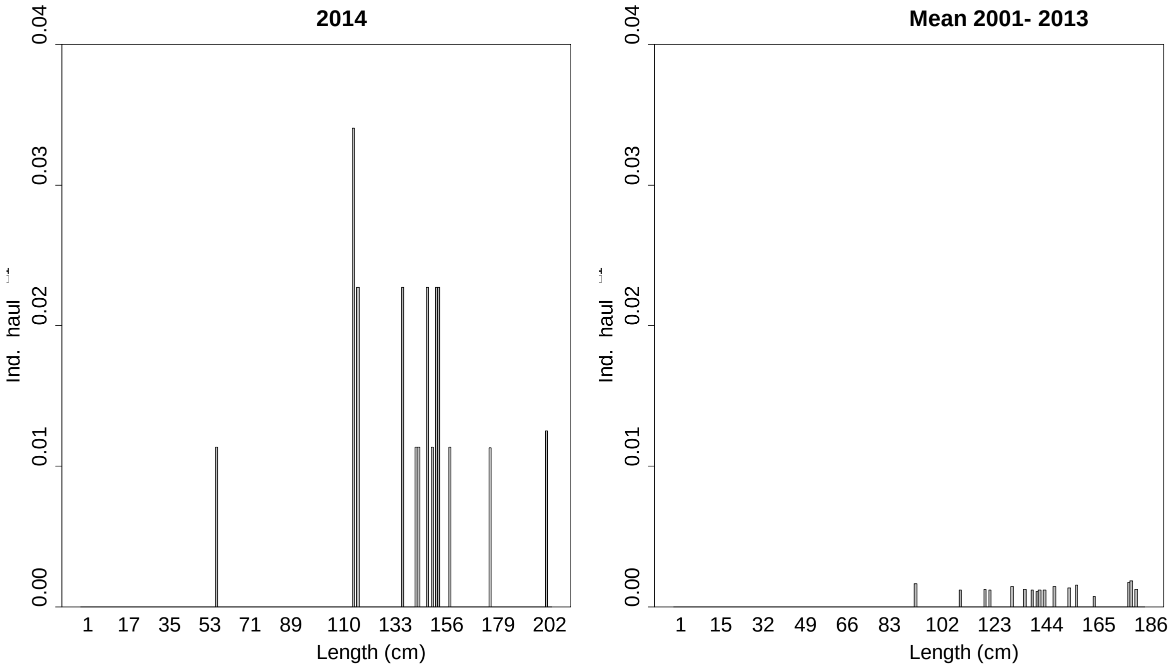

Figure 32 Stratified length distributions of *Dipturus nidarosiensis* in 2014 Porcupine survey, and mean values during Porcupine survey time series (2001-2013).

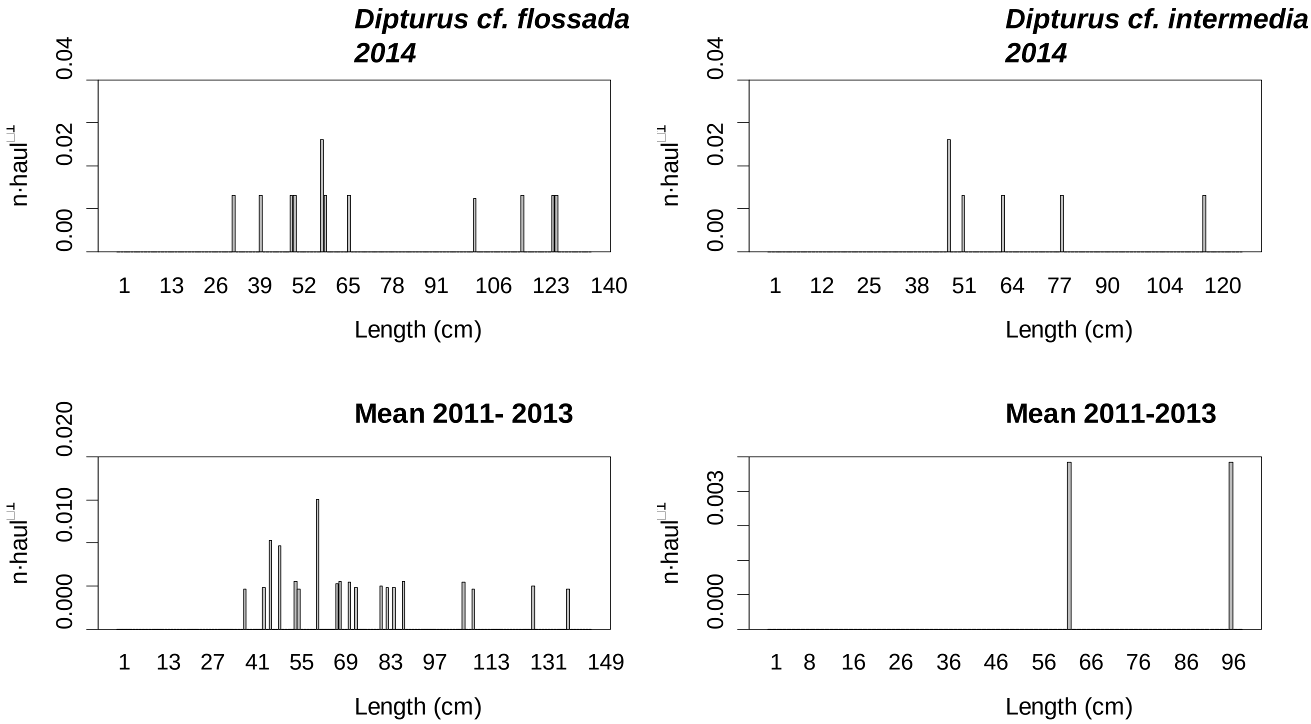

Figure 33 Stratified length distributions of *Dipturus cf. flossada* and *Dipturus cf. intermedia* in 2014 Porcupine survey, and mean values during Porcupine survey time series (2011-2013).